Increased Symptoms of Posttraumatic Stress in School Students Soon After the Start of the COVID-19 Outbreak in China

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Research article

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Abstract

Background: The outbreak of Coronavirus Disease 2019(COVID-19) caused psychological stress in Chinese adults population. But we are unaware of whether the pandemic causes psychological stress on children.

Methods: We used the Children's Impact of Event Scale questionnaire (CRIES-13) to investigate the degree of Post-traumatic Stress (PTSD) symptoms caused by the pandemic in students selected from schools in Sichuan, Jiangsu, Henan, Yunnan, and Chongqing provinces of China.

Results: A total of 7769 students(3692 male and 4077 female), aged 8-18 years, were enrolled in the study, comprising 1214 in primary schools, 2799 in junior high schools and 3756 in senior high schools. A total of 1639 students (21.1%) had severe psychological stress reactions. A large proportion of senior high school students (23.3%) experienced severe psychological stress, and they had the highest median total CRIES-13 score. Female students were more likely to experience severe psychological stress and had higher median CRIES-13 total scores than males.

Conclusion: COVID-19 has placed psychological stresses on primary and secondary school students in China. These stresses are more likely to reach severe levels among female students and senior high school students.

Background

Studies have shown an increased incidence of post-traumatic stress in survivors of large-scale disasters [1–4]. Disasters can be defined as destructive occurrences that disrupt and overwhelm entire communities and affect millions worldwide in a given year [5].Children who have experienced disasters are more vulnerable than adults to mental and psychological disorders, including post-traumatic stress disorder (PTSD)[6–8]. Disasters can severely affect their emotional status, resulting in stress reactions that are different from those experienced by adults [9, 10].In addition, children may develop serious psychological and mental illnesses that occur sooner and last longer than those in adults [11–13].

In the 21st century, a number of infectious diseases have challenged global public health [14]. During the epidemic of severe acute respiratory syndrome in February 2003, many adult patients developed post-traumatic stress symptoms, PTSD, anxiety, depression, and other mental illnesses[15–18].The current COVID-19 pandemic, caused by novel coronavirus SARS-CoV-2, constitutes a global public health disaster [19].We are unaware of studies of whether and how the pandemic causes psychological stress on children.

Therefore, we investigated the prevalence of post-traumatic stress symptoms in primary and secondary school students from several provinces and regions in China at one month after the start of the COVID-19 outbreak. Our results may help elucidate the effects of the pandemic on the psychological health of children.

Methods

Subjects

Participants included students from several primary and secondary schools in Sichuan, Jiangsu, Henan, Yunnan, and Chongqing. We included a range of students, from those attending first grade of primary school (8 years) to those in the third grade of senior high school (18 years). Participants were stratified into primary school students (grades1-6), junior high school students (grades7-9), and senior high school students (grades10-12).We excluded students with a history of substance abuse, those suffering from major physical and mental illnesses, including Axis I and Axis II disorders classified by the Diagnostic and Statistical Manual of Mental Disorders IV (DSM-IV) based on self-report; as well as those who could not understand the questionnaire.

The minimal sample size required for this study was calculated based on the typical sample size for questionnaire-based surveys of the occurrence of post-traumatic stress after disasters. Based on a PTSD prevalence of 32.2% in China after the outbreak of COVID-19[19], we calculated a minimal sample of 2097 for a power of 0.8, type I error of 0.05 and allowable error of 0.02. We increased this by 10% to 2330 to compensate for missing or uncooperative participants. Ultimately, our sample was much larger (7769).

Measurement

Between 1 February 20 and 1 March 1 2020, approximately one month after the outbreak of the novel coronavirus infection in China, we collected demographic and psychopathological data from the participants using the Chinese versions of the General Situation Collection Sheet revised in 2010 and the Children's Revised Impact of Event Scale (CRIES) questionnaire [20]. The two questionnaires were distributed via WeChat, and their purpose and contents were explained to all participants. Questionnaires couldn't be submitted until they completed all questions.

The CRIES-13 measures symptoms of intrusion (4 items), avoidance (4 items), and arousal (5 new items). Answer item is set as "not at all", "rarely", "sometimes", and "often" [20, 21]. The CRIES-13 total score is used to judge the severity of the psychological impact caused by a traumatic event. A total score ≥ 30 is considered to indicate severe psychological stress [21–23].

Statistical analysis

All statistical analyses were performed using SPSS 25.0(IBM, Armonk, NY, USA), and the significance level was set as $\alpha = 0.05$.We analyzed participant data and compared CRIES-13 scores across groups using the Chi-squared, Mann-Whitney U, and Kruskal-Wallis H tests. Post-hoc comparisons were conducted after adjusting the level of significance using Bonferroni correction.

We performed stepwise binary logistic regression using the forward likelihood ratio (LR) method in order to identify factors influencing perceived stress. We considered the influence of sex, age, grade, family structure, occupation of parents, past history of psychological illness (history of psychological consultations or use of psychotropic drug therapy), recent diagnosis of coronary disease, and exposure to coronavirus infection within the previous 30 days. Questions about infection exposure addressed the number of visits to Hubei province and surrounding areas, contact with patients diagnosed with COVID-19, incidence/occurrence of cold, fever, cough, nasal congestion, runny nose, sore throat, and diarrhea, and participation in large gatherings, such as dinner parties. Exposure was also assessed based on contact with family members who were doctors and frontline workers, as well as relatives within three generations who had been diagnosed with COVID-19 or were suspected of having coronary disease. We also included data on whether participants had received therapy against COVID-19, or had fever and other mild symptoms.

Results

Demographic and clinical characteristics of subjects

Our survey included a total of 7769 students (4077 female) from 5 different provinces in China (Table 1). All participants were between 8 and 18 years old (median 15 years), and were stratified into three groups based on their grade: primary school students (15.62%, median age 11 years), junior high school students (36.03%, median age 13 years), and senior high school students (48.35%, median age 16 years). In total, 24 participants (13 males and 11 females) were diagnosed with COVID-19, and 27 (16 males and 11 females) were suspected of being infected with the disease.

Table 1
Demographic characteristics of school students, stratified by sex and grade

Characteristic	Total (n = 7769)	Sex				Grade		
		Male (n = 3692)	Female (n = 4077)	Z/x2	p	Primary (n = 906)	Junior High (n = 2799)	Senior High (n = 3756)
Median age (years)	15	15	15	-1.910	0.056*	11.00	13.00	16.00
Sex (Male/Female)	-	-	-	-	-	611/603	1420/1379	1661/2095
Grade (Primary school/Junior high school/Senior high school)	1214/2799/3756	160/451/1420/1661	148/455/1379/2095	32.324	0.000*	-	-	-
Family structure				50.179	0.000*			
Single parent	794	346	448			72	252	470
Two parents	2608	1339	1269			160	1064	1384
Three-generation	2762	1350	1412			601	952	1209
Other	1605	657	948			381	531	693
Occupation of parents				34.448	0.000*			
Medical staff	160	86	74			7	108	45
Police	58	31	27			0	40	18
Civil servant	287	151	136			7	164	116
Teacher	195	102	93			12	114	69
Freelancer	1838	906	932			270	637	931
Farmer	1073	477	596			349	185	539
Researcher	12	8	4			0	8	4
Worker	1575	677	898			299	360	916
Self-employed	1586	797	789			166	761	659
Others	985	457	528			104	422	459
Family members								
Infected (Yes/No)	165/1604	70/3622	95/3982	1.757	0.185	9/1205	56/2743	100/3656
Doctor (Yes/No)	272/7497	145/3547	127/3950	3.785	0.052	14/1200	166/2633	92/3664
Frontline worker (Yes/No)	111/7658	51/3641	60/4017	0.112	0.738	18/1196	66/2733	27/3729
Respondent diagnosed with COVID-19	24/7745	13/3679	11/4066	0.426	0.514	6/1208	4/2795	14/3742
Respondent had contact with suspected COVID-19 patient (Yes/No)	27/7742	16/3676	11/4066	1.497	0.221	6/1208	4/2795	17/3739
Respondent received COVID-19 therapy (Yes/No)	157/7612	72/3620	85/3992	0.178	0.673	19/1195	34/2765	104/3652

We collected information about the family structure and occupation of the parents of all participants. A large proportion of participants lived in multi-generational households (35.6%) and in families with three individuals including the respondent (33.6%). Others had different family structures (20.7%) or lived with single parents (10.2%).The most frequent parental occupations were freelancers (23.7%), self-employed workers (20.4%), migrant workers (20.3%), and farmers (13.8%). A smaller proportion were medical workers (2.1%), police officers (0.7%), civil servants (3.7%), and teachers (2.5%).A total of 165 students had family members who had been diagnosed with COVID-19.Participants were also exposed to the virus via family members who were doctors (272 students) and frontline workers (111 students).

Total CRIES-13 score

The stress response of participants to the COVID-19 pandemic was measured based on CRIES-13 total score. A total of 1639 (21.1%) students experienced severe symptoms of psychological stress (total score ≥ 30; Table 2).These symptoms were more serious in senior high school students (23.3%) compared to primary students (20.3%) and junior high school students (18.4%) (χ^2 = 23.5, p < 0.001). A higher proportion of female students suffered severe psychological stress than male students (22.3% vs 19.7%; χ^2 = 8.03, p = 0.005).

Table 2
CRIES-13 scores of students, stratified by sex and grade

	Total	Male	Female	*z/x²*	p	Primary	Junior High	Senior High	*H/x2*	p
	(n = 7769)	(n = 3692)	(n = 4077)			(n = 906)	(n = 2799)	(n = 3756)		
Median scores										
Total	20	19	21	-5.739	0.000*	18.00	19.00	21.00	75.512	0.000*
Intrusion factor	8.00	7.00	8.00	-6.759	0.000*	6.00	8.00	8.00	104.141	0.000*
Avoidance factor	4.00	4.00	4.00	-3.146	0.002*	5.00	4.00	4.00	45.492	0.000*
Arousal factor	7.00	6.00	7.00	-8.563	0.000*	5.00	6.00	8.00	183.669	0.000*
Distribution by total score, n (%)										
< 30	6130 (78.9)	2964 (80.3)	3166 (77.7)	8.030	0.005*	967 (79.7)	2283 (81.60)	2880 (76.70)	23.503	0.000*
≥ 30	1639 (21.1)	728 (19.7)	911 (22.3)			247 (20.3)	516 (18.40)	876 (23.30)		

To understand the degree of impact of COVID-19, we compared total CRIES-13 scores among primary school, junior high school, and senior high school student susing the Kruskal-Wallis H test. We found a significant difference among the three groups (H = 75.512, p < 0.001; Table 2); median total CRIES-13 score was the highest for senior high school students (21), followed by the junior high school(19) and primary students (18).

After adjusting the level of significance using Bonferroni correction, a post-hoc comparison found that total CRIES-13 scores were significantly lower for primary school students (Z =-7.469, adjusted p < 0.001) and junior high school students(Z = -6.616, adjusted p < 0.001) than for senior high school students. However, total scores were not significantly different between primary school and junior high school students (Z=-2.368, adjusted p = 0.054; Table 3). Across all three student groups, female students had higher total scores than males (median 21 vs 19; Z=-5.739, p < 0.001; Table 2).

Table 3
The post-hoc comparison of CRIES-13 scores by grade

	Primary & Senior High		Junior High & Senior High		Primary & Junior High	
	z	Adjusted p	z	Adjusted p	z	Adjusted p
Total	-7.469	0.000*	-6.616	0.000*	-2.368	0.054
Intrusion factor	-10.120	0.000*	-2.463	0.041*	-7.933	0.000*
Avoidance factor	4.327	0.000*	-3.499	0.000*	6.7	0.000*
Arousal factor	-12.382	0.000*	-9.214	0.000*	-5.200	0.000*

Factor scores on the CRIES-13

We observed significant differences among the three groups of students in intrusion (H = 103.14, p < 0.001), arousal (H = 183.669, p < 0.001), and avoidance factor scores (H = 45.492, p < 0.001) (Table 2). Post-hoc comparisons of the intrusion factor showed that junior high school students had higher scores than primary students (Z=-7.933, adjusted p < 0.001), while senior high school students had higher scores than primary students (Z=-10.120, adjusted p < 0.001) and junior high school students (Z=-2.463, adjusted p = 0.041; Table 3).

Pairwise comparison of the arousal factor showed that junior high school students had higher scores than primary students (Z=-5.200, adjusted p < 0.001), and senior high school students had higher scores than primary students (Z=-12.382, adjusted p < 0.001) and junior high school students (Z=-9.214, adjusted p < 0.001). In contrast, primary school students had higher avoidance factor scores than junior high school students (Z = 6.7, adjusted p < 0.001) and senior high school students (Z = 4.327, adjusted p < 0.001), and the scores of junior high school students were lower than those of senior high school students (Z=-3.499, adjusted p < 0.001;Table 3).

Across all three student groups, we found that female students had higher intrusion factor (Z=-6.76, p < 0.001) and arousal factor scores (Z=-3.15, p < 0.001) than males, but lower avoidance factor scores (Z=-3.15, p = 0.002; Table 2).

Factors influencing individual stress response

We performed logistic regression to determine the factors affecting total CRIES-13 scores and stress responses. Our results showed that stress response was influenced by the sex of the participant($p = 0.024$), school grade ($p = 0.001$), past history of psychological counseling ($p < 0.001$), exposure to infection via relatives ($p = 0.009$), and a recent diagnosis of COVID-19 ($p = 0.006$; Table 4).Individuals suffering from cold, fever, cough, nasal congestion, runny nose, sore throat, and diarrhea within 30 days of taking part in the survey also had a heightened stress response ($p = 0.002$).

Table 4
Logistic regression analysis to identify factors that influence risk of severe psychological stress in students

Variable	B	SE	Wald chi-square	OR (95% CI)	p
Sex (Male/Female)	0.128	0.057	5.113	1.136 (1.017–1.270)	0.024*
Grade			13.860		0.001*
Primary	-0.146	0.083	3.073	0.864 (0.735–1.017)	0.080
Junior High	-0.234	0.064	13.200	0.940 (0.697–0.898)	0.000*
Occupation of parents			16.827		0.051
Medical staff	0.179	0.215	0.689	1.196 (0.784–1.824)	0.406
Police	0.280	0.327	0.732	1.323 (0.697–2.512)	0.392
Civil servant	0.171	0.169	1.029	1.186 (0.853–1.651)	0.310
Teacher	-0.396	0.230	2.957	0.673 (0.429–1.057)	0.085
Freelancer	0.183	0.100	3.341	1.201 (0.987–1.462)	0.068
Farmer	0.328	0.111	8.741	1.388 (1.117–1.725)	0.003*
Researcher	0.754	0.631	1.429	2.126 (0.617–7.325)	0.232
Worker	0.151	0.104	2.135	1.163 (0.950–1.425)	0.144
Self-employed	0.145	0.103	1.958	1.156 (0.944–1.415)	0.162
Psychological consultations (Yes/No)	0.646	0.131	24.389	1.908 (1.477–2.466)	0.000*
Relatives infected by COVID-19 (Yes/No)	0.451	0.173	6.779	1.570 (1.118–2.206)	0.009*
Respondent had contact with suspected COVID-19 patient (Yes/No)	-1.514	0.778	3.787	0.220 (0.048–2.206)	0.006*
Respondent diagnosed with COVID-19 (Yes/No)	1.937	0.703	7.594	1.570 (1.118–1.632)	0.006*
Respondent received COVID-19 therapy (Yes/No)	0.119	0.189	0.400	1.127 (0.778–1.632)	0.527
Respondent had cold, fever, cough etc. in the previous 30 days (Yes/No)	0.435	0.142	9.344	1.544 (1.169–2.040)	0.002*

Discussion

In this study, we examined the early effects of the COVID-19 pandemic on the mental and psychological health of 7769 school students in China using the CRIES-13. Based on total CRIES-13 scores, 1639students (21.1%) experienced symptoms of severe psychological stress, indicating an urgent need to understand the impact of such events on the mental health of children and adolescents.

Women are more likely to experience acute stress reactions and to be at higher risk of PTSD than men [24–30].In addition, women often show higher scores than men on the invasion and avoidance factors of the CRIES-13[31, 32]. These sex differences are associated with age, suggesting that older individuals respond differently to stressful events than younger ones [31–37]. Consistent with these results, we found that the largest proportion of students experiencing severe psychological stress were in senior high school. Similarly, studies of children exposed to war violence found older children to be more vulnerable to stress [38]. However, a survey of 8236 US children in grades 4–12 at 6 months after the 9/11 attacks found that primary school students (grades 4–5) were at higher risk of post-traumatic stress symptoms than junior and senior high school students [39]. This discrepancy may reflect that different grades of students may have different degrees of stress disorder under the influence of different events. Future research should focus on more different events.

We found that senior high school students had higher scores on arousal and invasion factors on the CRIES-13, but primary school students had higher avoidance factor scores. This suggests that senior high school students are more likely to feel frightened or anxious, experience flashback reactions associated with the event, and manifest symptoms of arousal. The immaturity of the cognitive process in younger children can make them less susceptible to recurring intrusive thoughts and other cognitive impacts of trauma [40, 41]. A maladaptive cognitive style in adolescents and older children may compromise their ability to regulate emotions, rendering them more vulnerable to PTSD [42].

Based on the regression analysis, we found that the occurrence of cold-related symptoms within one month of participating in the survey significantly influenced stress response. Based on studies of the spread of various viruses, psychosocial factors are related to experimental exposure and infection rates. C-reactive protein (CRP) is an acute-phase reactant downstream of the pro-inflammatory cytokines released during influenza infection [43].Studies have shown that a marker of peripheral inflammation, plasma CRP, may be prospectively associated with PTSD symptom emergence, suggesting that inflammation may predispose to PTSD [44].On the other hand, the increasing number of patients and suspected cases, and the increasing number of outbreak affected provinces

and countries have elicited public worry about becoming infected [45]. As we know, the most common symptoms associated with COVID-19 are fever, cough, dyspnea, expectoration, headache, and myalgia or fatigue [46]. This is similar to the symptoms of the common cold [47].Particularly, the relevance of perceived threat for health and life and the experienced feelings of vulnerability as mediating factors [48].It was repored that mental health symptoms may have been common during the COVID-19 outbreak among the general population in China, especially among infected individuals, people with suspected infection, and people who might have contact with patients with COVID-19 [49].This is consistent with our research results.

Although previous studies have explored the impact of the SARS epidemic on mental health, this is the first study addressing the psychological impact of COVID-19 on children and adolescents. Using a relatively large sample ranging widely in age, we were able to conduct a cross-sectional study of the mental and emotional status of students at one month after the outbreak began in China. There were no participants from Hubei province, which were subsequently identified as being caused by a novel coronavirus termed severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [19].However, this may have caused a bias since the participants were selected from schools in certain regions in China, resulting in findings that may not be generalizable across all children and adolescents. In addition, the survey involved substantially more high school students than primary school students. Even though the timing of the survey may help identify participants who require psychological and clinical intervention, the cross-sectional design meant that we could not assess how persistent the post-traumatic stress symptoms are.

Conclusions

In conclusion, our results showed that COVID-19 has placed psychological stresses on primary and secondary school students in China. These stresses are more likely to reach severe levels among female students and senior high school students.

Abbreviations

COVID-19\SARS-CoV-2: Coronavirus Disease 2019

CRIES-13: the Children's Impact of Event Scale questionnaire

PTSD: Post-Traumatic Stress Disorder

DSM-IV: the Diagnostic and Statistical Manual of Mental Disorders IV

SPSS: Statistical Product and Service Solutions

LR: likelihood ratio

CRP: C-reactive protein

Declarations

Ethics approval and consent to participate

This study was approved by the Ethics Committee of West China Hospital of Sichuan University. The research had been performed in accordance with the Declaration of Helsinki. Written informed consents had been attained from all the participants and their guardians based on the principle of self determination. The participants'rights were fully respected and preserved in the whole process of this study

Consent for publication

Not applicable.

Availability of data and material

The data that support the findings of this study are available on request from the corresponding author (Li Yin, yli009@163.com). The data are not publicly available due to privacy or ethical restrictions.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

LY conceived and designed the experiments. HM X , HZ , LJ H , XL W, XW T, YP W, QQ X, PX , RQ J, JZ, FD, MY Y, DL, XJ L, CL Z, WJ W, LL , HM C, WC Z , HP Z, WW helped collect the data. HM X, HZ analyzed the data. HM X, HZ and LY wrote and revised the manuscript. All authors have read and approved the manuscript.

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References

1. Neria Y, Nandi A, Galea S: **Post-traumatic stress disorder following disasters: a systematic review**. *Psychol Med* 2008, **38**(4):467-480.
2. Zeng EJ, Bordeaux Silverstein L: **China earthquake relief: Participatory action work with children**. *School Psychology International* 2011, **32**(5):498-511.
3. Baum N, Rahav G, Sharon M: **Heightened susceptibility to secondary traumatization: A meta-analysis of gender differences**. *Am J Orthopsychiatry* 2014, **84**(2):111-122.
4. Furr JM, Comer JS, Edmunds JM, Kendall PC: **Disasters and youth: a meta-analytic examination of posttraumatic stress**. *J Consult Clin Psychol* 2010, **78**(6):765-780.
5. **International Federation of Red Cross and Red Crescent Societies:World disasters report.** *Oxford University Press; Oxford, England* 1998
6. Norris FH, Slone LB, Baker CK, Murphy AD: **Early physical health consequences of disaster exposure and acute disaster-related PTSD**. *Anxiety, Stress & Coping* 2006, **19**(2):95-110.
7. Becker-Blease KA, Turner HA, Finkelhor D: **Disasters, victimization, and children's mental health**. *Child Dev* 2010, **81**(4):1040-1052.
8. Adams ZW, Danielson CK, Sumner JA, McCauley JL, Cohen JR, Ruggiero KJ: **Comorbidity of PTSD, Major Depression, and Substance Use Disorder Among Adolescent Victims of the Spring 2011 Tornadoes in Alabama and Joplin, Missouri**. *Psychiatry* 2015, **78**(2):170-185.
9. Kenardy J, Smith A, Spence SH, Lilley PR, Newcombe P, Dob R, Robinson S: **Dissociation in children's trauma narratives: an exploratory investigation**. *J Anxiety Disord* 2007, **21**(3):456-466.
10. Pfefferbaum B: **Posttraumatic stress disorder in children: a review of the past 10 years**. *J Am Acad Child Adolesc Psychiatry* 1997, **36**(11):1503-1511.
11. Pynoos RS, Steinberg AM, Layne CM, Briggs EC, Ostrowski SA, Fairbank JA: **DSM-V PTSD diagnostic criteria for children and adolescents: a developmental perspective and recommendations**. *J Trauma Stress* 2009, **22**(5):391-398.
12. Fairbank JA, Fairbank DW: **Epidemiology of child traumatic stress**. *Curr Psychiatry Rep* 2009, **11**(4):289-295.
13. Alisic E, van der Schoot TA, van Ginkel JR, Kleber RJ: **Looking beyond posttraumatic stress disorder in children: posttraumatic stress reactions, posttraumatic growth, and quality of life in a general population sample**. *J Clin Psychiatry* 2008, **69**(9):1455-1461.
14. Laaser U, Brand H: **Global health in the 21st century**. *Glob Health Action* 2014, **7**:23694.
15. Cheng SK, Tsang JS, Ku KH, Wong CW, Ng YK: **Psychiatric complications in patients with severe acute respiratory syndrome (SARS) during the acute treatment phase: a series of 10 cases**. *Br J Psychiatry* 2004, **184**:359-360.
16. Chua SE, Cheung V, McAlonan GM, Cheung C, Wong JW, Cheung EP, Chan MT, Wong TK, Choy KM, Chu CM *et al*: **Stress and psychological impact on SARS patients during the outbreak**. *Can J Psychiatry* 2004, **49**(6):385-390.
17. Cheng SK, Wong CW, Tsang J, Wong KC: **Psychological distress and negative appraisals in survivors of severe acute respiratory syndrome (SARS)**. *Psychol Med* 2004, **34**(7):1187-1195.
18. Wu KK, Chan SK, Ma TM: **Posttraumatic stress, anxiety, and depression in survivors of severe acute respiratory syndrome (SARS)**. *J Trauma Stress* 2005, **18**(1):39-42.
19. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, Zhang L, Fan G, Xu J, Gu X *et al*: **Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China**. *Lancet* 2020, **395**(10223):497-506.
20. Lau JT, Yeung NC, Yu XN, Zhang J, Mak WW, Lui WW, Zhang J: **Validation of the Chinese version of the Children's Revised Impact of Event Scale (CRIES) among Chinese adolescents in the aftermath of the Sichuan Earthquake in 2008**. *Compr Psychiatry* 2013, **54**(1):83-90.
21. Perrin S Meiser-Stedman R Smith P: **The children's revised impact of event scale(CRIES):validity as a screening instrument for PTSD**. *BehavCogn Psychother* 2005,**33**:487-498
22. Dyregrov A, Kuterovac G, Barath A: **Factor analysis of the impact of event scale with children in war**. *Scand J Psychol* 1996, **37**(4):339-350.
23. Zhang N, Zhang Y, Wu K, Zhu Z, Dyregrov A: **Factor structure of the Children's Revised Impact of Event Scale among children and adolescents who survived the 2008 Sichuan earthquake in China**. *Scand J Psychol* 2011, **52**(3):236-241.
24. Pine DS, Cohen JA: **Trauma in children and adolescents: risk and treatment of psychiatric sequelae**. *Biol Psychiatry* 2002, **51**(7):519-531.
25. Lai J, Ma S, Wang Y, Cai Z, Hu J, Wei N, Wu J, Du H, Chen T, Li R *et al*: **Factors Associated With Mental Health Outcomes Among Health Care Workers Exposed to Coronavirus Disease 2019**. *JAMA Netw Open* 2020, **3**(3):e203976.
26. Liu N, Zhang F, Wei C, Jia Y, Shang Z, Sun L, Wu L, Sun Z, Zhou Y, Wang Y *et al*: **Prevalence and predictors of PTSS during COVID-19 outbreak in China hardest-hit areas: Gender differences matter**. *Psychiatry Res* 2020, **287**:112921.
27. Christiansen DM, Hansen M: **Accounting for sex differences in PTSD: A multi-variable mediation model**. *Eur J Psychotraumatol* 2015, **6**:26068.
28. Alisic E, Jongmans MJ, van Wesel F, Kleber RJ: **Building child trauma theory from longitudinal studies: a meta-analysis**. *Clin Psychol Rev* 2011, **31**(5):736-747.

29. Ma X, Liu X, Hu X, Qiu C, Wang Y, Huang Y, Wang Q, Zhang W, Li T: **Risk indicators for post-traumatic stress disorder in adolescents exposed to the 5.12 Wenchuan earthquake in China**. *Psychiatry Res* 2011, **189**(3):385-391.
30. Perrin M, Vandeleur CL, Castelao E, Rothen S, Glaus J, Vollenweider P, Preisig M: **Determinants of the development of post-traumatic stress disorder, in the general population**. *Soc Psychiatry Psychiatr Epidemiol* 2014, **49**(3):447-457.
31. Hampel P, Petermann F: **Age and gender effects on coping in children and adolescents**.*Journal of Youth and Adolescence* 2005,**34**:73-83.
32. Tekin A, Karadag H, Suleymanoglu M, Tekin M, Kayran Y, Alpak G, Sar V: **Prevalence and gender differences in symptomatology of posttraumatic stress disorder and depression among Iraqi Yazidis displaced into Turkey**. *Eur J Psychotraumatol* 2016, **7**:28556.
33. Ahmad N, Hussain S, Munir N: **A tale of internal displacement: Post Traumatic Stress Disorder (PTSD) among school students in Swat, Pakistan**. *Rawal Medical Journal* 2018,**43**(3):511–514.
34. Vindegaard N, Benros ME: **COVID-19 pandemic and mental health consequences: Systematic review of the current evidence**. *Brain Behav Immun* 2020, **89**:531-542.
35. Yun-Li Y E , Ya L , Min C: **Trajectory and the related factors of PTSD in secondary school students after earthquake**.*Chin J Sch Health* 2011, **32**:166–167.
36. Felton JW, Cole DA, Martin NC: **Effects of rumination on child and adolescent depressive reactions to a natural disaster: the 2010 Nashville flood**. *J Abnorm Psychol* 2013, **122**(1):64-73.
37. Xu W, Yuan G, Liu Z, Zhou Y, An Y: **Prevalence and predictors of PTSD and depression among adolescent victims of the Summer 2016 tornado in Yancheng City**. *Arch Psychiatr Nurs* 2018, **32**(5):777-781.
38. Ulset VS, Czajkowski NO, Kraft B, Kraft P, Wikenius E, Kleppesto TH, Bekkhus M: **Are unpopular children more likely to get sick? Longitudinal links between popularity and infectious diseases in early childhood**. *PLoS One* 2019, **14**(9):e0222222.
39. Hoven CW, Duarte CS, Lucas CP, Wu P, Mandell DJ, Goodwin RD, Cohen M, Balaban V, Woodruff BA, Bin F *et al*: **Psychopathology among New York city public school children 6 months after September 11**. *Arch Gen Psychiatry* 2005, **62**(5):545-552.
40. Galea S, Nandi A, Vlahov D: **The epidemiology of post-traumatic stress disorder after disasters**. *Epidemiol Rev* 2005, **27**:78-91.
41. Guthrie R, Bryant R: **Attempting suppression of traumatic memories over extended periods in acute stress disorder**. *Behav Res Ther* 2000, **38**(9):899-907.
42. Ehlers A, Mayou RA, Bryant B: **Cognitive predictors of posttraumatic stress disorder in children: results of a prospective longitudinal study**. *Behav Res Ther* 2003, **41**(1):1-10.
43. Vasileva D, Badawi A: **C-reactive protein as a biomarker of severe H1N1 influenza**. *Inflamm Res* 2019, **68**(1):39-46.
44. Eraly SA, Nievergelt CM, Maihofer AX, Barkauskas DA, Biswas N, Agorastos A, O'Connor DT, Baker DG, Marine Resiliency Study T: **Assessment of plasma C-reactive protein as a biomarker of posttraumatic stress disorder risk**. *JAMA Psychiatry* 2014, **71**(4):423-431.
45. Bao Y, Sun Y, Meng S, Shi J, Lu L: **2019-nCoV epidemic: address mental health care to empower society**. *Lancet* 2020, **395**(10224):e37-e38.
46. Acter T, Uddin N, Das J, Akhter A, Choudhury TR, Kim S: **Evolution of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) as coronavirus disease 2019 (COVID-19) pandemic: A global health emergency**. *Sci Total Environ* 2020, **730**:138996.
47. Halstead P, Arbuckle R, Marshall C, Zimmerman B, Bolton K, Gelotte C: **Development and Content Validity Testing of Patient-Reported Outcome Items for Children to Self-Assess Symptoms of the Common Cold**. *Patient* 2020, **13**(2):235-250.
48. Lee SM, Kang WS, Cho AR, Kim T, Park JK: **Psychological impact of the 2015 MERS outbreak on hospital workers and quarantined hemodialysis patients**. *Compr Psychiatry* 2018, **87**:123-127.
49. Shi L, Lu ZA, Que JY, Huang XL, Liu L, Ran MS, Gong YM, Yuan K, Yan W, Sun YK *et al*: **Prevalence of and Risk Factors Associated With Mental Health Symptoms Among the General Population in China During the Coronavirus Disease 2019 Pandemic**. *JAMA Netw Open* 2020, **3**(7):e2014053.